

CH2

Graphics Functions

- A graphics system performs multiple tasks to produce output and handle user input.
- These functions are divided into *seven* major groups:

1. Primitive functions
2. Attribute functions
3. Viewing functions
4. Transformation functions
5. Input functions
6. Control functions
7. Query functions

1. The primitive functions

- define the *low-level objects or atomic entities* that our system can display. بتخلي النظام يرسم أبسط الحاجات
- Depending on the API, the primitives can include points, line segments, polygons, pixels, text, and various types of curves and surfaces.
- These primitives are usually those that can be displayed rapidly on the hardware.

The usual sets include points, line segments, polygons, and sometimes text

33	The _____ functions define the low-level objects or atomic entities that our system can display including points, line segments, polygons, pixels, text and various types of curves and surfaces. a) Transformation b) Attribute c) Viewing Primitive In Computer Graphics. produced when a line is generated as a series of small
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2. Attribute functions

- allow us to perform operations ranging from choosing the color with which we display a line segment, to picking a pattern with which to fill the inside of a polygon, to selecting a typeface for the titles on a graph.
- بتسمحك تتحكم في شكل الحاجات اللي بترسمها (تختار لون , تخلي المجسم من جوه متلون او فيه خطوط , تختار نوع الخط اللي هتكتب بيه)

Note :- If primitives are the what of an API—the primitive objects that can be displayed—then attributes are the how.

1. The functions allow us to perform operations ranging from choosing the color with which we display a line segment to picking a pattern with which to fill the inside of a polygon, to selecting a typeface for the title on a graph.
- a) Transformation
 - b) Attribute
 - c) Viewing
 - d) Primitive

3. The viewing functions

- allow us to specify various views.

4. Transformations functions

- One of the characteristics of a good API is that it provides the user with a functions that allows set of transformation her to carry out transformations of objects, such as rotation, translation, and scaling

- تسمحك إنك تغير شكل أو مكان الحاجة المرسومة.

2. The functions allow us to carry out transformation of objects, such as rotation, translation and scaling.
- a) Transformation
 - b) Attribute
 - c) Viewing
 - d) Primitives

5. Input functions

- For interactive applications, an API must provide a set of input functions to allow us to deal with the diverse forms of input that characterize modern graphics systems.
- We need functions to deal with devices such as keyboards, mice, and data tablets.

6. Control functions

- in any real application , we also have to worry about handling the complexities of working in a multiprocessing , multi window environment usually an environment where we are connected to a network and there are other users.
- Control functions enable us to communicate with the window system, to initialize our programs, and to deal with any errors that take place during the execution of our programs

- ال Control function بتساعدنا اننا نتواصل مع ال (Window System) و نبدا تشغيل البرنامج بشكل سليم (Initialize Programs) و نتعامل مع اي اخطاء تحصل اثناء التشغيل

	(a) Attribute	(b) Control	(c) Viewing	(d) Input
53	The _____ functions enable us to communicate with the window system, to initialize our programs, and to deal with any errors that take place during the execution of our programs.			
	(a) Attribute	(b) Control	(c) Viewing	(d) Input

7. Query functions.

- within our applications we can often use other information within the API, including camera parameters or values in the frame buffer. A good API provides this information through a set of query functions.
- جوا البرامج اللي بنكتبها، ساعات بنحتاج نعرف شوية معلومات موجودة أصلاً جوا ال API زي مثلاً اعدادات الكاميرا او البيانات الموجودة في ال frame buffer او نعرف اكثر عن كل الادوات اللي موجوده

Primitives and Attributes

- Within the graphics community, there has been an ongoing debate about which primitives should be supported in an API.
- يقولك ان ديما في نقاش حوالين هل احنا لازم نضيف كل الاشكال في ال API ولا نحت الاشكال الاساسيه بس
- *Minimal systems* typically support lines, polygons, and some form of text (strings of characters), all of which can be generated efficiently in hardware
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- We can separate primitives into *two* classes:

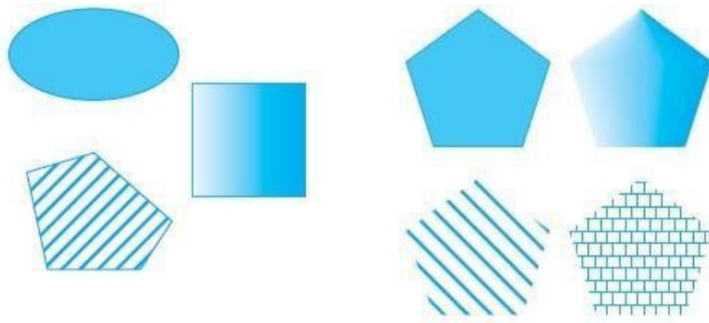
1. **Geometric primitives** اشكال هندسيه

2. **image, or raster, primitives.** اشكال صوريه

- Geometric primitives are specified in the problem domain and include points, line segments, polygons, curves, and surfaces. هي اشكال اللي بنحدها باستخدام القوانين و المعادلات
- A point can be displayed as a single pixel or a small group of pixels
- Finite sections of lines between two vertices, called *line segments*.
- you can use a sequence of line segments to connect data values for a graph.
- ممكن تستخدم مجموعه من القطع المستقيمة علشان توصل بين قيم البيانات في رسم بياني
- You can also use line segments to display the edges of closed objects, such as polygons, that have interiors
- كمان تقدر تستخدم الخطوط المستقيمة دي علشان ترسم حدود الأشكال المغلقة، زي ال (polygons) اللي بيكون ليها مساحة داخلية
- **Polygons** play a special role in computer graphics because we can display them rapidly and use them to approximate arbitrary surfaces.
- ليها دور مهم جدًا في الجرافيكس، لان الكمبيوتر يقدر يعرضها بسرعة، (Polygons) ال- وكمان نقدر نستخدمها علشان نقدر بيها نمثل بشكل تقريبي أي سطح معقد حتى لو كان مش منتظم

We can render a polygon in a variety of ways:

1. We can render only its edges, نرسم الحدود بس
2. we can render its interior with a solid color or a pattern. نملاه من جوه بلون ثابت او خطوط (نقشه يعني)
3. we can render or not render the edges او نقش .. نرسم الحدود و نملاه بلون او نقش نرسمه من غير حدود

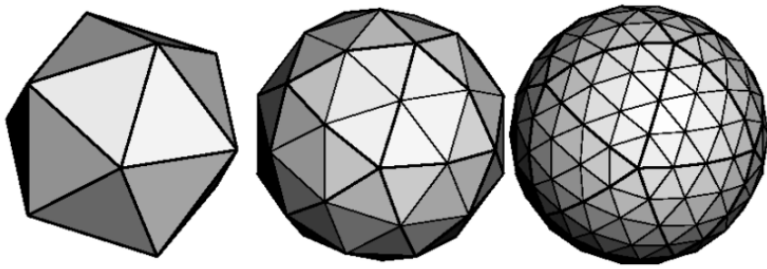


Filled objects. Methods of displaying a polygon

Approximating a Sphere

- Triangles can be displayed in three ways:
 1. as points corresponding to the vertices
 2. as edges
 3. with the interiors filled.
- The *third way is the default one*
- لما نرسم كوره في الجرافيكس بنقسم سطحها لمجموعة مثلثات صغيرة علشان نقدر نمثلها على الكمبيوتر. والمثلثات دي ممكن نعرضها بثلاث طرق:-

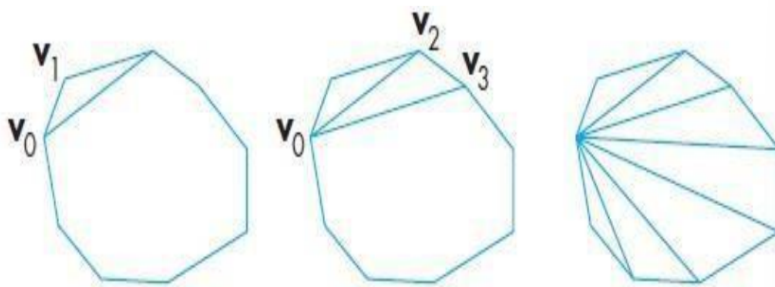
1. نعرض رؤوس المثلثات بس
2. نعرض الحواف (Edges) بس
3. تلوين الداخل (تعبئه داخله)



Sphere approximation with triangles.

Triangulation

- the triangle is simple, flat, and convex. Consequently, triangles are easy to render.
- The usual strategy is to start with a list of vertices and generate a set of triangles consistent with the polygon defined by the list, a process known as triangulation
- ال Triangulation يعني تحويل شكل هندسي زي ال polygon مثلا الي مجموعه من المثلثات بحيث نقدر نرسم الشكل بسهولة على الكمبيوتر
- طب اشمعنا المثلث؟ علشان هو ابسط شكل هندسي ممكن نرسمه باستخدام 3 نقط و المثلث ديما مستوي (flat) و محدبه (convex)
- ازاي العمليه بتم ؟ اننا بنبدا بمجموعه من النقط اللي بتحدد حدود الشكل و بعدين بنقسم الشكل لمجموعه من المثلثات الصغيره اللي بتغطي نفس المساحه



Recursive triangulation of a convex polygon

1	The process of starting with a list of vertices and generate a set of triangles consistent with the polygon defined by the list is called _____			
	a) Transformation	b) Convexity	c) Approximation	d) Triangulation

Text

- Graphical output in applications such as data analysis and display requires annotation, such as labels on graphs.
- لما تيجي تعرض بيانات في برنامج بيحلل أو بيعرض رسومات بيانية، بتحتاج تضيف شوية معلومات زيادة زي تسميات المحاور (Y و X) أو عنوان فوق الرسم، علشان اللي بيتفرج يفهم الرسم ده بيقول إيه
- Fonts are families of typefaces of a particular style, such as Times, Computer Modern, or Helvetica

There are *two* forms of text: stroke and raster.

- عندنا نوعين من الخط
- Stroke يعني بيترسم بخطوط وزوايا
- Raster يعني بيتخزن كصورة فيها بكسلات
- 1. **Stroke** text is constructed as are other geometric objects بيتبني زي أي شكل هندسي، يعني بتستخدم فيه نقط وخطوط علشان ترسم الحروف
- We use vertices to specify line segments or curves that outline each character. بنحدد شكل كل حرف عن طريق مجموعة نقط وبنوصلهم بخطوط أو منحنيات، علشان نرسم الحرف.
- If the characters are defined by closed boundaries, we can fill them.
- لو الحرف مرسوم بخط مغلق (يعني دايرة أو شكل مقفول)، نقدر نلون الجزء اللي جواه
- 1. **Raster** text is simple and fast.
- Characters are defined as rectangles of bits called *bit blocks*.

- كل حرف بيتخزن على شكل مستطيل صغير مليون أرقام 0 و 1، وده اسمه bit block، يعني شكل الحرف متخزن كصورة بسيطة بالأبيض والأسود
- Each block defines a single character by the pattern of 0 and 1 bits in the block
- ترتيب الـ 0 و 1 جوا الـ bit block هو اللي بيرسم شكل الحرف، زي صورة مرسومة بنقط صغيرة.
- A raster character can be placed in the frame buffer rapidly by a bit-block transfer Operation
- بنقدر نعرض الحرف بسرعة على الشاشة عن طريق إننا ناخد نسخة جاهزة من شكله (اللي هي bit block) ونحطها في الـ (frame buffer) باستخدام عملية اسمها **bit-block transfer**.

Model- 2	
44	In Computer Graphics, there are two forms of text: stroke and raster where _____ is constructed as are other geometric objects.
	(a) Stroke text (b) Font (c) Polyline (d) Depth
45	Two successive uniform scaling with scaling factors, a, b, is equivalent to a uniform scaling defined by the scaling factor

5. By we use vertices to specify line segments or curves that outline each character.

- Raster text
- Stroke text**
- Bit blocks
- Triangulation

6. By characters are defined as rectangles of bits called bit blocks with each block defined a single character by the pattern of 0 and 1 bits in the block.

- Raster text**
- Stroke text
- Bit blocks
- Triangulation

Curved Objects

- We can take *two* approaches to creating a richer set of objects.
- First, we can use the **primitives that we have** to approximate curves and surfaces.
- The other approach, is to start with the **mathematical definitions of curved objects** and then **build graphics functions**

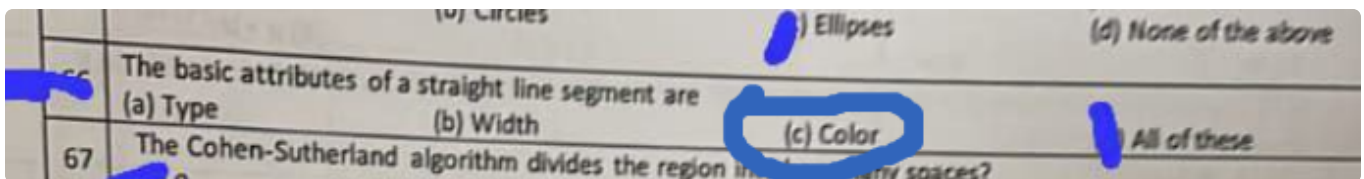
• عندنا طريقتين نقدر نستخدمهم علشان نرسم أشكال منحنية

1. الطريقة الأولى: نستخدم الأشكال الأساسية اللي عندنا (زي الخطوط والمضلعات) علشان نقرب بيها شكل المنحنيات والأسطح.

2. الطريقة الثانية: بنرسم المنحنيات باستخدام معادلات رياضية زي الدوال، وبنخلي برنامج الجرافيكس يفهم المعادلات دي ويرسم الشكل المنحني على الشاشة مباشرة.

Attributes

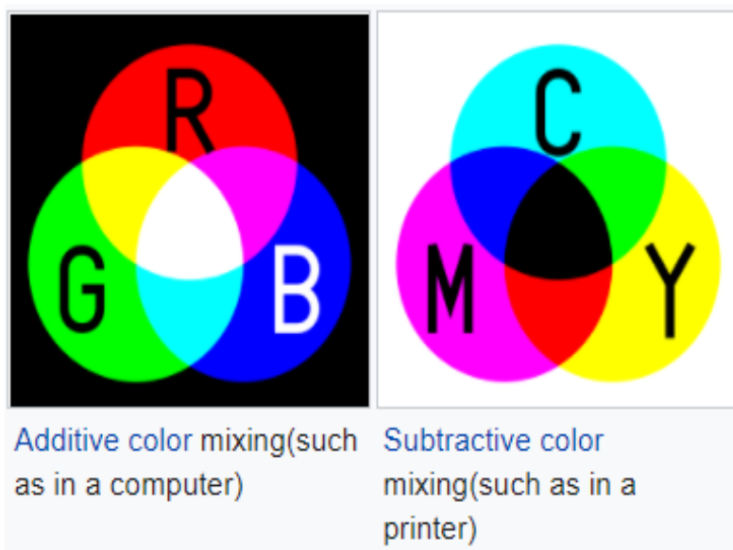
- Properties that describe **how** an object should be **rendered** are called attributes.
- Available attributes **depend on the type of object**. For example, a line could be black or green. It could be solid or dashed.
- A polygon could be filled with a single color or with a pattern



Color

- Color is one of the most interesting aspects of both human perception and computer graphics.
- We can use the model of the human visual system to obtain a **simple but useful color model**

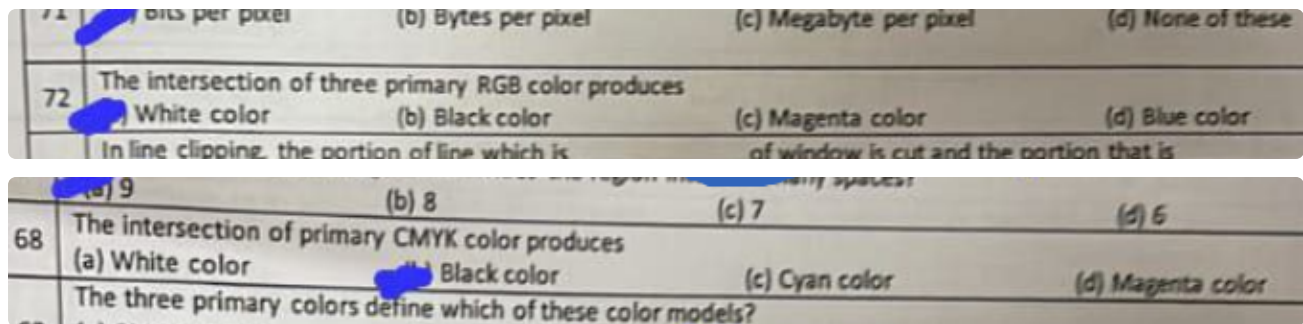
- A visible color can be characterized by a function $C(\lambda)$ that occupies wavelengths from about 350 to 780 nm.
- The value for a given wavelength λ in the visible spectrum gives the intensity of that wavelength in the color. كل قيمة عند طول موجي معين في الطيف المرئي (السطوع) عند الطول ده داخل اللون بتحدد شدة الضوء.
- The human visual system has *three* types of cones responsible for color vision.
- a display needs only *three primary colors* to produce the three tri-stimulus values needed for a human observer.
- عشان أي شاشة تخلي الإنسان يشوف الألوان هي محتاجة تستخدم 3 ألوان أساسية بس (أحمر وأخضر وأزرق) عشان تولد القيم الثلاثة اللي العين بتحتاجها للإحساس بأي لون.
- The CRT is one example of the use of additive color, where the primary colors add together to give the perceived color.
- In **subtractive systems**, the primaries are usually the *complementary colors*: cyan, magenta, and yellow
- You need to know only that an RGB additive system has a dual with a CMY subtractive system
- كل اللي محتاج تعرفه هو إن ال (RGB) اللي في الشاشات فيه نظام مكافئ فيه بس بيشتغل بالعكس، اسمه (CMY)



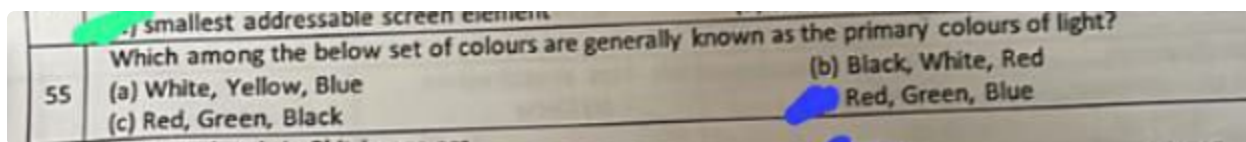
Note :- In RGB, mixing all colors gives white

Note :- In CMY, mixing all colors gives black.

Note :- CMY is used in printing because it works by subtracting light reflected from paper.



- We can view a color as a point in a **color solid**.
- We draw the solid using a coordinate system corresponding to the three primaries.
- The distance along a coordinate axis represents the amount of the corresponding primary in the color
- كل لون نقدر نمثله كنقطة جوه شكل ثلاثي الأبعاد (color solid)، مبني على ألوان أساسية زي الأحمر والأخضر والأزرق، وكل محور في الشكل بيعبر عن كمية كل لون في اللون النهائي



RGB Color

- In a three-primary-color, additive-color **RGB** system, there are conceptually separate buffers for red, green, and blue images.
- Each pixel has separate red, green, and blue components that correspond to locations in memory
- كل بكسل على الشاشة بيتخزن في الذاكرة على شكل 3 أرقام: واحد للأحمر وواحد للأخضر وواحد للأزرق. وده بيساعدنا نكوّن أي لون عن طريق دمج القيم دي.
- In a typical system, there might be a 1280×1024 array of pixels, and each pixel might consist of 24 bits (3 bytes): 1 byte for each of red, green, and blue.

- يعني شاشة الكمبيوتر العادية بتكون مكونة من شبكة فيها 1280 بكسل عرض × 1024 بكسل طول. يعني فيها عدد كبير جدًا من ال (pixels) اللي بتتقسم ل 3 بايت كل بايت للون من الثلاثة

- **Transparency** and **opacity** are complements of each other.
- الشفافية (transparency) والعتمة (opacity) عكس بعض. يعني لما واحدة تزيد، الثانية تقل
- An opaque object passes no light through it
- a transparent object passes all light.
- Opacity values can range from fully transparent ($A=0.0$) to fully opaque ($A=1.0$).

57	(a) 0	(b) 1	(c) 255	
	If an object allows most all light to pass through it then it is			
58	(a) transparent	(b) opaque	(c) translucent	(d) clear

Question

3. is a set of successive vertices (and line segments) that are to be connected.

- Polygon
- Strip
- Segment
- Polyline**

4. can be defined for an object that has a border that can be described by a line loop but also has a well-defined interior.

- Polygon**

	(a) Attribute	(b) Control	
	Pixel is defined as		
54	(a) medium sized screen element	(b) largest addressable screen element	
	(c) smallest addressable screen element	(d) all of the above	